

REMARKS

This Response is filed in response to a Final Office Action dated July 25, 2007.

Upon entry of this response, claims 12-24 will be pending in the Application, claims 12, 13, 15-18 and 20 have been amended, claims 21-24 have been added. No new matter has been added by the amendments, as support for the amendments is found in the disclosure as originally filed.

In the outstanding Office Action, the Examiner rejected claims 17 and 18 under 35 U.S.C. 103 as obvious over Steibel et al. 6,280,550, hereinafter referred to as "Steibel et al.", in view of JP-6-137103, hereinafter referred to as "JP '103", and Baldwin et al. 5,279, 892, hereinafter referred to as "Baldwin", and rejected claims 12-20 under 35 U.S.C. 103(a) as being unpatentable over Steibel et al. in view of JP'103, Baldwin and Steibel et al. 6,258,737, hereinafter referred to as "Steibel et al. '737".

Response to Argument

Applicant thanks the Examiner for the telephone Interview on October 24, 2008, at which time Applicant discussed the believed distinguishing characteristics of Applicant's invention over the prior art. Applicant also discussed a proposal to include amending the claims to include the "homogeneously solid" structure of the core insert section to further distinguish over the hollow core inserts of Steibel et al.

Applicant continues to disagree with the Examiner's position that Baldwin is directed to the field of making composite turbine blades in the same field as Steibel et al. Baldwin is directed to the field of making composite engine fan blades based on a cured resin materials, not turbine blades, which are subject to substantially different operating conditions as discussed in the Turbine Section of "Jet Engines" provided to the Examiner in the Information disclosure statement submitted on June 9, 2008. The currently claimed invention, in contrast, is directed to high temperature turbine blades, based on high temperature ceramic materials, for high temperature applications in the hot gas compression stage of a turbine. The materials and methods for fabricating the particular blades in the different fields would not be of interest to one of ordinary skill in the art, the

operating conditions and environments and the characteristics of both blades being extremely dissimilar.

Applicant believes that while Baldwin discloses a composite preform used in the dovetail of "composite blades", Baldwin's invention is limited to a cloth/resin composite insert, which is bonded to the outer plies during the curing process. Furthermore, the preform of Baldwin extends from the airfoil section of the blade into the root section of the blade, and there is no reason to believe that such a continuous insert of Baldwin would work in the invention of Steibel et al.

Baldwin provides no suggestion to provide composite preform inserts in the method of manufacturing a ceramic blade as found in the pending claims. Lastly, no suggestion is made to use a silicon melt infiltration process to form a bond between the insert and the outer shell preform, as also found in the present claims.

Additionally, the Examiner has argued in the Final Rejection of January 1, 2008, that motivation exists for making this modification to Steibel et al. as provided for under the Graham v. Deere test by stating that the insert would enhance producibility and reduce the number of prepreg layers required. This motivation fails in light of the differences in material and manufacturing limitations as claimed. One of ordinary skill at the time before the pending claimed invention would not have appreciated that providing an insert in the dovetail of a ceramic blade operated under the conditions for the ceramic blade would have any likelihood of success. Steibel et al. discloses inserts in the airfoil, and not the dovetail, the two parts of the blade having dissimilar operating conditions, particularly operating stress and stiffness requirements, and the dissimilar operating conditions would be recognized by one of ordinary skill in the art. Furthermore, the inserts of Steibel et al. are used to form open channels in the airfoil section of the blade, and would not be extended into the dovetail section as appreciated by one of ordinary skill in the art.

As set forth in MPEP §2141, the references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention. Furthermore, MPEP 2141 states that when applying 35 U.S.C. 103, the following tenets of patent law must be adhered to:

- (A) The claimed invention must be considered as a whole;
- (B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination;

(C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention; and

(D) Reasonable expectation of success is the standard with which obviousness is determined.

Hodosh v. Block Drug Co., Inc., 786 F.2d 1136, 1143 n.5, 229 USPQ 182, 187 n.5 (Fed. Cir. 1986).

In Summary, the Baldwin reference do not teach or suggest or otherwise provide the motivation to modify Steibel et al. to arrive at Applicant's invention of a core insert section having the claimed composition or formed by the manufacturing limitations in the dovetail section of a turbine blade. In addition, Applicant has now amended the claims to include homogeneously solid core insert section, in contrast to the hollow insert sections of Steibel et al., which are used to provide cooling to the blade portion of the turbine blade.

Additionally, Applicant provides further discussion as to why the requirements for forming a rejection under 35 U.S.C. 103 have not been met by the Examiner under further grounds, and why the claims are allowable over the cited prior art, in the individual rebuttals to the rejections as found hereinafter in the discussion below.

Rejections under 35 U.S.C 103

A. Steibel et al. in view of JP '103 and Baldwin

The Examiner has rejected claims 17 and 18 under 35 U.S.C. 103(a) as being obvious over Steibel et al. in view of JP'103 and Baldwin.

Specifically, the Examiner stated that:

"Steibel et al. 6,280,550 discloses a method of making a composite turbine blade comprising: providing first reinforcement comprising an insert preform of silicon carbide fabric rigidized by deposited silicon carbide (silicon carbide-silicon carbide composite preform having porosity); optionally depositing matrix material to fill only a portion of the porosity of the insert preform (silicon-silicon carbide composite preform having some porosity); providing second reinforcement comprising silicon carbide fabric plies preform); applying the silicon carbide fabric plies to contact the insert and define the surface shape of the blade; and depositing matrix material into the porosity of the first and second reinforcement, the depositing also providing bonding between the first and second reinforcements. Matrix material may be deposited by melt infiltration of silicon so that the matrix is silicon carbide or mixture of silicon and silicon carbide (col. 2-7). Steibel et al. do not disclose providing the composite turbine blade with a dovetail section by inserting an insert preform in the dovetail section."

The Examiner then brings in a secondary reference stating:

"JP 6-137103 teaches that a fiber reinforced composite turbine blade, such as of fiber strengthening ceramic (ceramic matrix composite), is made with a dovetail section using reinforced fiber which extends from the dovetail section to the lade part (Abstract and computer translation)."

The Examiner adds a third reference stating:

"Baldwin teaches that in making composite airfoils (fan blades), inserts or "preforms" are provided in both the blade part to form the core of the blade and in the root part (dovetail) of the blade. The inserts are made to be of the same composite material as the composite material layered over the inserts to form the composite blade. Using inserts enhance probability and eliminated hundreds of prepreg layers, especially in the thick root sections (col. 2, lines 13-57, col. 4, lines 44-46)."

The Examiner then concludes:

"It would have been obvious to one of ordinary skill in the art to have modified the method of Steibel et al. for making a composite turbine blade by making the turbine blade with dovetail section, as taught by JP'103 as provided as part of a turbine blade and also made during the fabrication of a fiber reinforced composite blade. Providing the fabric plies (outer shell section preform) to extend from the blade part to a dovetail section to form both the blade and dovetail section of a turbine blade in one step of matrix deposition would have been obvious to one of ordinary skill in the art, as JP'103 teaches that the reinforcing fiber for a turbine blade extends from the blade to the dovetail section.

Providing an insert preform not only in the blade section, but also in the dovetail section would have been obvious to one of ordinary skill in the art, as Baldwin teaches that a composite fan blade having a root part (dovetail) is provided with insert (insert preform) not only in the blade part but also in the dovetail part in order to enhance producibility and reduce the number of prepreg layers, especially in the thick dovetail section. Providing an insert (insert preform) in the dovetail section as silicon carbide fabric rigidized by deposited silicon carbide (silicon carbide-silicon carbide composite preform having porosity), or silicon-silicon carbide composite preform having some porosity, would have been obvious to one of ordinary skill in the art to provide the insert preform in the dovetail section similar to that provided in the blade section to allow for deposition of matrix by silicon melt infiltration, as disclosed by Steibel et al. It would have been obvious to one of ordinary skill in the art that , in making a silicon carbide-silicon carbide composite turbine blade using insert preforms in both the blade part and dovetail part, to provide the insert preforms as similar in composition to each other and to the fabric plies which are to contact the insert preforms, as Baldwin et al. teach that the insert in the blade part and dovetail part are similar in composition and to that of the prepreg layers (plies) to enhance producibility and to reduce the number of prepreg layers required, especially in the thick dovetail part of the blade. The use of the same type of insert preform in the dovetail section as used in the blade section would have been obvious to one of ordinary skill in the art, as clearly suggested by Baldwin, to make a composite blade.

Further, by providing a second reinforcement of silicon carbide fabric plies for defining the surface shape of the blade and into which silicon can be deposited by met infiltration, an outer shell preform having at least some porosity is obviously provided."

Applicant's respectfully traverse the rejection of claims 17 and 18 under 35 U.S.C. 103(a).

The following principle of law applies to all Section 103 rejections. MPEP 2143.03 provides "To establish prima facie obviousness of a claimed invention, all claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). All words in a claim must be considered in judging the patentability of that claim against the prior art. In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA

1970)." [emphasis added] That is, to have any expectation of rejecting the claims over a single reference or a combination of references, each limitation must be taught somewhere in the applied prior art. If limitations are not found in any of the applied prior art, the rejection cannot stand. In this case, the applied prior art reference, applied individually, clearly do not arguably teach some limitations of the claims.

Steibel et al., as understood, is directed to a method of forming a composite article, such as a turbine vane, formed by preparing a porous first-region piece and then applying at least one second-region layer. Steibel et al. discloses wherein the first-region piece is rigidized prior to applying the at least one second-region layer. Steibel et al. further discloses at Figure 5 and supporting discussion wherein said process is used to form a turbine vane.

The Examiner then brings in a secondary reference to JP '103 and a third reference to Baldwin, to try to cure deficiencies of the primary reference to incorporate an insert of the claimed composition into the dovetail by the claimed method of manufacture.

Applicant asserts that the combination of references do not render obvious Applicant's claimed invention. In particular, the combination of references fails to disclose inserts as limited by the claim language of this pending application to composition and processing steps within the claimed invention.

Claim 17, as amended, provides for:

"providing a homogeneously solid core insert section having a preselected geometry, the core insert section comprising a material selected from the group consisting of a silicon carbide-silicon carbide composite preform having at least some porosity, a silicon-silicon carbide composite, the silicon-silicon carbide composite preform having at least some porosity, and a monolithic ceramic;"

and

"assembling the homogeneously solid core insert section and the outer shell preform into a turbine blade form, the turbine blade form comprising a dovetail section and an airfoil section, wherein the homogeneously solid core insert section is positioned in the dovetail section of the turbine blade form; and

filling remaining porosity in the turbine blade form with at least silicon using the silicon melt infiltration process, the filling also forming a bond between the homogeneously solid core insert section and the outer shell preform."

The above limitations are not taught nor obvious from the combined art. The combined art does not disclose the selection of material nor the bond formation of the core inserts as claimed.

The preforms of Steibel et al. are used in forming a vane portion of a turbine component, and more particularly, are taught to form component parts wherein the preforms are used in areas of hollow passageways or cooling channels. Additionally, the Applicant finds that the entire disclosure of Steibel et al. is directed to the vane section of the turbine blade and is completely silent as to the dovetail section of the blade. As discussed in Applicant's Specification at [0027], "The turbine blade 20 is mounted to a turbine disk (not shown) by a dovetail 24 that extends downwardly from the airfoil 22 and engages a slot of similar geometry of the turbine disk. Applicant similarly stated at [0040] that "The turbine blade 20 is mounted to a turbine disk (not shown) by a dovetail 24 that extends downwardly from an engages a slot on the turbine disk where it is secured in position." Steibel et al. '550 makes no reference to a dovetail section.

Thus, the teaching of Steibel et al. does not teach or suggest the insert material and formation in the dovetail section by the claimed manufacturing limitations. Furthermore, one of ordinary skill in the art, aware of the differences in desired characteristics between the vane or airfoil portion of the turbine blade and the dovetail portion of the turbine blade, and the differences in the operating conditions to which these different parts of the components would be exposed, would not find obvious the interchangeability of components, including inserts, and the ability to perform silicon melt infiltration into the dovetail to form a bond between the insert and the outer shell preform. In addition, the preforms of Steibel et al. are hollow to provide cooling channels to the blade portion. It would be obvious, nor would motivation be provided, to provide hollow preforms as taught by Steibel et al., which are used to provide cooling to the blade portion of the turbine blade into a dovetail section.

These deficiencies of Steibel et al. are not cured by the secondary references. At best, JP '103 teaches that the reinforcing fibers of the turbine vane extend into the dovetail section. This fails to cure Steibel et al.'s deficiencies by failing to provide a teaching that the preforms would be positioned within these extended reinforcing fibers in the dovetail region.

Furthermore, Baldwin's teaching as to inserts being known in the dovetail section of a cloth/resin blade, fails to cure the deficiencies of Steibel et al.. The inserts of the prior art do not possess the claimed limitations to composition or method of bonding within the

dovetail, nor bring to the primary reference motivation to alter the primary reference as recited in the pending independent claims.

Baldwin cannot cure the deficiencies of Steibel et al. since Baldwin is non-analogous art. For Baldwin et al. to cure the deficiencies of Steibel et al., Baldwin must be properly combinable with Steibel et al.

Baldwin is directed to a cloth/resin composite blade. The composite blade may include an insert formed of the same or similar material as the composite blade. Baldwin discloses a cloth/resin insert in the dovetail bonded overlaid prepregs by resin bonding. Baldwin is thus directed to a method of manufacturing a composite resin/cloth blade including curing to bond the cloth/resin insert to the outer cloth/resin plies, as compared to Steibel which is directed to bonding a ceramic prepreg insert by a silicon melt infiltration process to bond the insert to the outer prepreg layers to form a ceramic blade. One of ordinary skill in the art would not combine Baldwin with Steibel et al. to bond the insert in the dovetail of Steibel et al. by melt infiltration. Such a combination would be clearly hindsight and lacks motivation.

The Examiner argues that Baldwin is only being used to teach that inserts can be provided to the dovetail section, by stating

"Baldwin teaches that in making composite airfoils (fan blades), inserts or "preforms" are provided in both the blade part to form the core of the blade and in the root part (dovetail) of the blade. The inserts are made to be of the same composite material as the composite material layered over the inserts to form the composite blade. Using inserts enhance probability and eliminated hundreds of prepreg layers, especially in the thick root sections (col. 2, lines 13-57, col. 4, lines 44-46)."

However, one of ordinary skill would not suspect or believe that a resin/cloth process teaching would be applicable to a silicon melt infiltration process, and that such a teaching would be applicable to the materially different starting materials, and used in blades intended for different application environments and conditions.

In summary, the Examiner has failed to show how the combination of references produce a method of forming a ceramic matrix composite turbine blade having the claimed material and process limitations.

Applicant asks that the Examiner reconsider and withdraw this ground of rejection.

B. Steibel et al. in view of JP '103 and Baldwin and Steibel et al. '737

The Examiner has rejected claims 12-20 under 35 U.S.C. 103(a) as obvious over Steibel et al. in view of JP '103 and Baldwin and Steibel et al. '737.

Specifically, the Examiner stated:

"Steibel et al. 6,280,550 discloses a method of making a composite turbine blade comprising: providing first reinforcement comprising an insert preform of silicon carbide fabric rigidized by deposited silicon carbide (silicon carbide-silicon carbide composite preform having porosity); optionally depositing matrix material to fill only a portion of the porosity of the insert preform (silicon-silicon carbide composite preform having some porosity); providing second reinforcement comprising silicon carbide fabric plies (preform); applying the silicon carbide fabric plies to contact the insert preform and define the surface shape of the blade; and depositing matrix material into the porosity of the first and second reinforcement, the depositing also providing bonding between the first and second reinforcements. Matrix material may be deposited by melt infiltration of silicon so that the matrix is silicon carbide or mixture of silicon and silicon carbide. As shown in Figure 7, the insert is provided in the dovetail section of the blade (col. 2-7). Steibel et al. do not specifically disclose providing the composite turbine blade with a dovetail section by inserting an insert preform in the dovetail section."

The Examiner added a secondary reference, further stating:

"JP 6-137103 teaches that a fiber reinforced composite turbine blade, such as of fiber strengthening ceramic (ceramic matrix composite), is made with a dovetail section using reinforcing fiber which extended from the dovetail section to the blade part (Abstract and computer translation)."

The Examiner then added a third reference, stating:

"Baldwin teaches that in making composite airfoils (fan blades), inserts or "preforms" are provided in both the blade part to form the core of the blade and in the root part (dovetail) of the blade. The inserts are made to be of the same composite material as the composite material layered over the inserts to form the composite blade. Using inserts enhance probability and eliminated hundreds of prepreg layers, especially in the thick root sections (col. 2, lines 13-57, col. 4, lines 44-46)."

The Examiner then added a fourth reference, further stating:

"Steibel et al. '737 teaches that in making a silicon carbide composite by melt infiltration with silicon, the silicon carbide fiber fabric is impregnated with high char yield slurry to form a prepreg before melt infiltration. The use of a high char yielding resin improves increases burnout strength, produces a hard, tough preform and provides integrity to the preform structure during silicon melt infiltration. Steibel et al. further teach that before melt infiltration, the impregnated fabric (prepregged cloth) is either subjected to compression molding, bladder molding or autoclaving to form a preform for melt infiltration. Steibel et al. also teach that carbon of micrometer particle size provided in silicon carbide preforms to give different composite properties of structure (col. 5, line 50 - col. 6, line 11, col. 6, line 64 - col. 7, line 12).

The Examiner then makes an obviousness statement, stating:

"It would have been obvious to one of ordinary skill in the art to have modified the method of Steibel et al. for making a composite turbine blade by making the turbine blade with a dovetail section, as taught by JP'103 as provided as part of a turbine blade and also made during the fabrication of a fiber reinforced composite blade.

Providing the fabric plies (outer shell section preform) to extend from the blade part to a dovetail section to form both the blade and dovetail section of a turbine blade in one step of matrix deposition would have been obvious to one of ordinary skill in the art, as JP103 teaches that the reinforcing fiber for a turbine blade extends from the blade to the dovetail section.

Providing an insert preform in the dovetail section would have been obvious to one of ordinary skill in the art, as the admitted prior art teaches that the preform inserts are used in the dovetail section to build up the thickness. Providing the insert preform in the dovetail section as silicon carbide fabric rigidized by deposited silicon carbide (silicon carbide-silicon carbide composite preform having porosity), or silicon-silicon composite preform having some porosity, would have been obvious to one of ordinary skill in the art to provide the insert preform in the dovetail section similar to that provided in the blade section to allow for deposition of matrix by silicon melt infiltration, as disclosed by Stebel et al. It would have been obvious to one of ordinary skill in the art that, in making a silicon carbide-silicon carbide composite turbine blade using insert preforms in both the blade part and dovetail part, to provide the insert preforms as similar in composition to each other and to the fabric plies which are to contact the insert preforms, as Baldwin et al. teach that the insert in the blade part and dovetail part are similar in composition and to that of the prepreg layers (plies) to enhance producibility and to reduce the number of prepreg layers required, especially in the thick dovetail part of the blade. The use of the same type of insert preform in the dovetail section as used in the blade section would have been obvious to one of ordinary skill in the art, as clearly suggested by Baldwin, to make a composite blade.

It would have been obvious to one of ordinary skill in the art to further modified the method of Steibel et al. for making a composite turbine blade by providing the second reinforcement as impregnated with high char yielding slurry (prepregged or a preform) before contacting the insert preform, as taught by Stebel et al. '737, as impregnated in silicon carbon fiber fabric before silicon melt infiltration to increase burn-out strength, produce a hard, tough preform and provide integrity during silicon melt infiltration."

The Examiner then further added:

"Autoclaving the assembly of second reinforcement prepreg and insert preform before silicon melt infiltration, as claimed in claim 12, would have been obvious to one of ordinary skill in the art, as taught by Steibel et al. '737, to aid in forming the prepreg into preform shape before melt infiltration. It would have been obvious to have autoclaved to help shape the prepregged plies into the surface shape of the blade.

Providing the silicon-silicon carbide insert preform with carbon microspheres, as claimed in claims 14 and 19, would have been obvious to one of ordinary skill in the art, as taught by Steibel et al. '737, as added to silicon carbide preforms to give different composite properties of structure. The use of carbon microspheres in either of the insert to second reinforcement preform would have been obvious to one ordinary skill in the art depending on desired composite properties of the insert or the surface of the composite turbine blade."

Applicants respectfully traverse the rejection of claims 12-20 under 35 U.S.C.
§103(a).

Independent claim 12, as amended, recites:

"providing a homogeneously solid core insert section having a preselected geometry, the core insert section comprising a material selected from the group consisting of silicon carbide-silicon carbide composite preform having at least some porosity, silicon-silicon carbide composite, silicon-silicon carbide composite preform having at least some porosity, and a monolithic ceramic;"

and

"assembling the homogeneously solid core insert section and the outer shell section into a turbine blade form, the turbine blade form comprising a dovetail section and an airfoil section, wherein the homogeneously solid core insert section is positioned in the dovetail section of the turbine blade form;"

and independent claim 17, as amended, recites:

"providing a homogeneously solid core insert section having a preselected geometry, the core insert section comprising a material selected from the group consisting of a silicon carbide-silicon carbide composite preform having at least some porosity, a silicon-silicon carbide composite, the silicon-silicon carbide composite preform having at least some porosity, and a monolithic ceramic;"

and

"assembling the homogeneously solid core insert section and the outer shell preform into a turbine blade form, the turbine blade form comprising a dovetail section and an airfoil section, wherein the homogeneously solid core insert section is positioned in the dovetail section of the turbine blade form;"

The Examiner has not shown that Steibel et al. teaches, as discussed in detail above in the traversal of the rejection of claim 17 under 35 U.S.C. 103 in Section A, positioning a core insert of the claimed composition into the dovetail section and further processing by silicon melt infiltration process to bond the insert to the outer prepregs. Figure 7 of Steibel et al. provides no disclosure as to a dovetail section and is only concerned with the airfoil section of a turbine blade. Furthermore, this defect is not cured by the secondary references to JP '103 or Baldwin et al. as further discussed above in Section A.

The addition of a fourth reference to Steibel et al. '737 fails to correct the deficiencies of the prior art.

Steibel et al. '737 is directed to a method of forming a silicon carbide-containing preform. Steibel et al. '737 provides no teaching or suggestion to position a core insert

section in the dovetail section of a turbine blade. Furthermore, the Examiner has not shown that Steibel et al. '737 provides any disclosure concerning the dovetail section in general.

Therefore, for the reasons given above, independent claims 12 and 17 are believed to be distinguishable from Steibel et al. in view of JP 6-137103, Baldwin et al., and Steibel et al. '737. In addition, dependent claims 13-16 and 18-20 are believed to be allowable as depending from what is believed to be allowable dependent claims 12 and 17 for the reasons given above.

Applicant asks that the Examiner reconsider and withdraw this ground of rejection.

New claims 21-24

Dependent claims 21-24 are believed to be allowable as depending from what is believed to be allowable dependent claims 12 and 17 for the reasons given above.

In addition, claims 21 and 22, further limit claims 12 and 17, respectively, to wherein the homogeneously solid core insert section is prefabricated, which is not taught or made obvious in light of the cited prior art. Also, claims 23 and 24, further limit claims 12 and 17, respectively, to wherein the homogeneously solid core insert section is stiffer than the outer shell section and to wherein the homogeneously solid core insert section is stiffer than the outer shell preform section, which is not taught or made obvious in light of the cited prior art.

CONCLUSION

In view of the above, Applicants respectfully request reconsideration of the Application and withdrawal of the outstanding rejections. As a result of the amendments and remarks presented herein, Applicants respectfully submit that claims 17 and 18 are not rendered obvious by Steibel et al. in view of JP '103 and Baldwin, and thus are in condition for allowance. In addition, Applicants respectfully submit that claims 12-20 are not rendered obvious by Steibel et al. in view of JP '103, Baldwin, and Steibel et al. '737. As the claims are not anticipated or rendered obvious by the applied art, Applicants request allowance of claims 12-24 in a timely manner. Applicants submit that no new matter has been added by the amendments to the claims. If the Examiner believes that prosecution of this Application could be expedited by a telephone conference, the Examiner is encouraged to contact the Applicants.

The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to Deposit Account No. 50-1059.

Respectfully submitted,

/Daniel J. Jenkins/

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